

Key Bridge Global LLC

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Implementation Standard for White Space Operations

*Format for WSIF Distribution and Exchange
(WDEF)*

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1 Important Notices

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1.2 Amendments and Review

This document describes a generalized implementation strategy for white space administration and is not an official Standard. While Key Bridge is the primary author, this document includes and has been developed through a collaborative process and incorporates suggestions and editorial advice from many contributors.

The ultimate intent of the authors is to evolve this document, mature its implementation and provide it as a formal contribution such that it may become an Implementation Specification. Nevertheless, while the material in this document has been carefully reviewed, it remains subject to change without notice and should not be referred to as a formal Standard or Specification.

The authors welcome your feedback. Recipients of this document are invited to submit their comments, and if applicable, notification and supporting documentation, to Key Bridge Global by email to documents@keybridgeglobal.com or to the following mailing address:

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3 Introduction

This document specifies computer software object models and their corresponding XML encoding for the **Distribution and Exchange of WSIF Data (WDEF)** between and amongst designated whitespace administrators and the various parties and agents that may wish to receive white space-related wireless service information.

The purposes of this document are to:

- Provide a set of standard machine-readable message formats that enable the distribution and exchange of WSIF encoded data in a secure, open and Rules-compliant manner
- Provide a standardized messaging information format to more efficiently support cross-domain frequency coordination and administration as may be useful for white space-related and other wireless services
- Support the implementation of white space administration in the TV broadcast bands through the secure exchange of white space-related wireless service information
- Enable the convenient storage, retrieval and archival of wireless service reservation transactions

The software object models defined by this document build upon the core **Wireless Service Information Format (WSIF)** specification as well as other common data primitives utilized and defined in related frameworks. The WDEF is an XML-based information encoding and formatting scheme that builds and relies upon several other standard XML schema specifications. The following specifications are included by reference:

Schema	XSD Prefix	XSD Namespace URN
XSD	xs	http://www.w3.org/2001/XMLSchema
XMLDSIG	ds	http://www.w3.org/2000/09/xmlsig
WSIF	-	http://keybridgeglobal.com/2011/xml/wsif.xsd

4 Approach

In developing this **WSIF Distribution and Exchange Format (WDEF)** the authors have attempted to incorporate and build upon other open and mature standards wherever possible. In cases where no satisfactory standard, data model or representation could be found the authors have attempted to follow best and standard practices whenever a new, original data model is required.

In some instances an existing standard representation required modification to establish FCC rules-compliance, and in these cases the original specification was kept wholly intact with the required modification added in a manner matching the original standard's organizing strategy.

The WDEF is intended to support white space operations within the TV Bands and beyond, and incorporates features and conventions necessary to accommodate the following necessary functions:

- Administrator Synchronization

White Space Rules describe the minimum set of information that must be contained within a white space database and also require that multiple administrators exchange this information at least once every 24 hours.¹ WSIF supports all inter-administrator information exchange as required by the Rules and also needed for practical implementation of White space operations.

- Data Queries

White Space Rules describe the minimum set of information that must be exchanged when a requesting party wishes to query and receive white space information from an administrator depending upon the purpose. WSM accommodates multiple query types, from TV Band devices requesting frequency information for the purpose of initiating a wireless transmission to network planning inquiries seeking general occupancy data to consumers inquiring about spectrum availability.

- Distributed Functionality

The wireless service information format may carry all information contained within FCC database records through its enumerated attributes and elements and support for extensions.

- Non-TVBD Services

WSIF may also be used as a basis to provide general contextual information about all types of wireless transmitters and services, and may serve as a foundation for extending white space operations into new frequency bands.

¹ See 47 CFR § 15.713(b)(2)

5 Terms and Definitions

Computer software objects and their corresponding XML Types not defined in this document are defined in the Wireless Service Information Format (WSIF) specification.²

Term	Definition
Administrator	A government-authorized whitespace administrator
WSIF	The Wireless Service Information Format specification

5.1 Units

The formats and units in the WSIF attribute definitions are the units of exchanged data. With regard to definitions and structure the WSIF specification makes the following fundamental assumptions for units of power, frequency and geodetic datum.

5.1.1 Power

WSIF power is exchanged in units of dBW in accordance with ITU treaty procedures, with power in dBW is calculated as:

$$P_{dBW} = 10 \log_{10} P_W$$

where

P_{dBW} = Power in dBW

P_W = Power in Watt

5.1.2 Frequency

WSIF frequency values are always noted in MHz. WSIF follows common practice and ITU convention in which a frequency value is formatted with between zero to five decimal places. Accordingly, all WSIF frequencies are measured and communicated in units of MHz, where the minimum allowable unit of frequency is 1.0 Hz. Frequency units are not otherwise explicitly declared.

5.1.3 Geodetic datum

All WSIF geo-location references are measured and communicated using the World Geodetic System of 1984 (WGS84) geodetic datum unless otherwise noted.³

² See Key Bridge Global LLC, *Wireless Service Information Format (WSIF)*

³ See United States Department of Defense; *DoD WGS-1984 – Its Definition and Relationships with Local Geodetic Systems*; Washington, D.C.; 1985; Report AD-A188 815 DMA; 6127; 7-R-138-R; CV, KV;

6 Protocol Versions

The following protocol versions should be applied when using the specifications described in this document. The revision number may be optionally noted but is not required.

Object	Protocol Version	Revision Number
wirelessServiceRecord	2.0	0

6.1 Protocol Security

This specification describes data formatting and encoding strategies to enable standardized messaging and exchange of WSIF information.

The WSIF Distribution and Exchange Format (WDEF) and the Wireless Service Information Format (WSIF) upon which it builds are composed of standard XML and therefore are compatible with many commonly available message encryption and transport security technologies.

However, actual message encryption, counter-party authentication, communications transport and other security aspects of a working system are beyond this document's scope. Rules-compliant information assurance and WDEF-based protocol security is the responsibility of each implementing party.

7 The WDEF Object Model Overview

The WDEF may be generally considered as a standardized encrypted WSIF message wrapper that may be used to securely record, exchange and distribute WSIF data in a Rules-compliant manner.⁴ An expanded WSM *wirelessServiceRecor* object is shown in **Error! Reference source not found.**

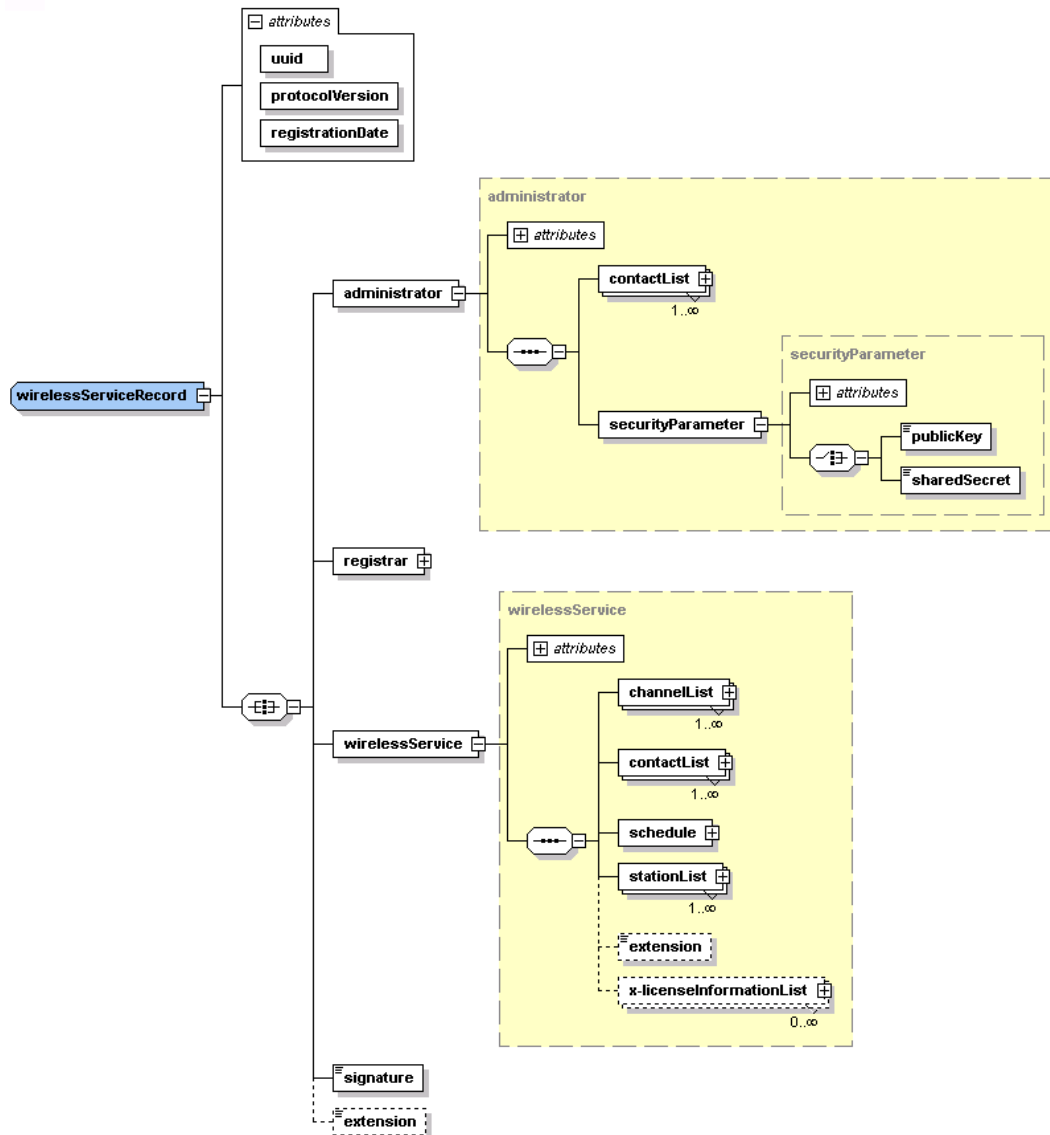
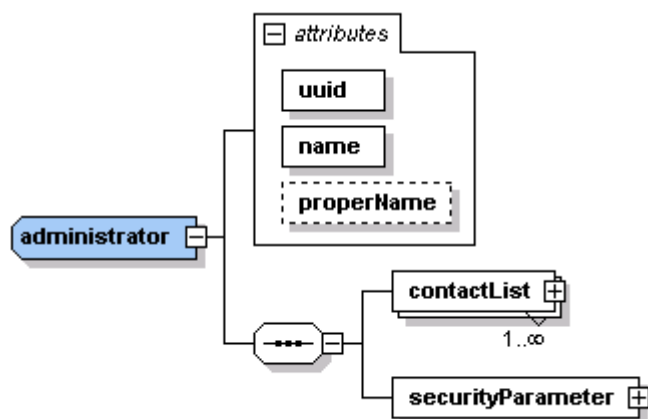


Figure 1: Expanded WDEF wirelessService object showing the WSIF wirelessService object that is encrypted using information contained in the WDEF administrator and signature elements.

⁴ See 47 CFR Part 15, Subpart H: *Television Band Devices*. Specific data exchange, transaction handling and security requirements may be found throughout the Rule.

7.1 administrator (also registrar)



The WDEF *administrator* object describes a white space spectrum administrator, which must be either a Government agency or private party that has been designated or otherwise authorized to provide white space spectrum administration services.

A WDEF administrator object may also support identification of a WDEF *registrar*.

Within WDEF the concept of a registrar is established to accommodate differential origination of WSIF wirelessService information.

WSIF wirelessService information may originate from a number of sources; including regulators, administrators, or other authorized third parties.⁵ The information originator is defined as the registrar.

7.1.1 Definition

```

<xs:complexType name="administrator">
  <xs:sequence>
    <xs:element name="contactList" type="contact" maxOccurs="unbounded"/>
    <xs:element name="securityParameter" type="securityParameter"/>
  </xs:sequence>
  <xs:attribute name="uuid" type="xs:string" use="required"/>
  <xs:attribute name="name" type="xs:string" use="required"/>
  <xs:attribute name="properName" type="xs:string"/>
</xs:complexType>
  
```

⁵ See 47 CFR 15.715 - *TV bands database administrator*: “The Commission may, at its discretion, permit the functions of a TV bands database, such as a data repository, registration, and query services, to be divided among multiple entities”

7.1.2 Elements

Element	Type	Documentation
contactList	contact	<p>A list of WSIF <i>contact</i> objects.</p> <p>Identifies one or more representatives of the administrator.</p> <p><i>Key Bridge implementation</i></p> <p>Three (3) enumerated administrator contact roles are defined and may be assigned to contacts by setting their respective <i>contactType</i> attribute. See <i>Administrator Contact Types</i> in <i>Designated Administrators</i>.</p>
securityParameter	securityParameter	<p>A WSIF <i>securityParameter</i> object.</p> <p>The administrator's security information including supported security modes and protocols plus their public key used for message signature and authentication.</p>

7.1.3 Attributes

Attribute	Type	Documentation
uuid	xs:string	<p>A universally unique identifier (UUID) assigned to, or created and published by, the administrator as a convenience token to identify all correspondence and information sent to or received from an administrator.</p>
name	xs:string	<p>An abbreviated, unique, machine-friendly name of the administrator.</p> <p><i>Key Bridge implementation</i></p> <p>Name field is formatted uppercase (ALL CAPS), is limited to maximum 16 characters, and may not contain any non-alpha characters (i.e. the allowed character set is [A-Z], no spaces, underscore, hyphen, etc.).</p> <p>For example: “KEYBRIDGE”.</p>
<i>properName</i>	xs:string	<p>The administrators full name.</p> <p>For example: “Key Bridge Global LLC”</p>

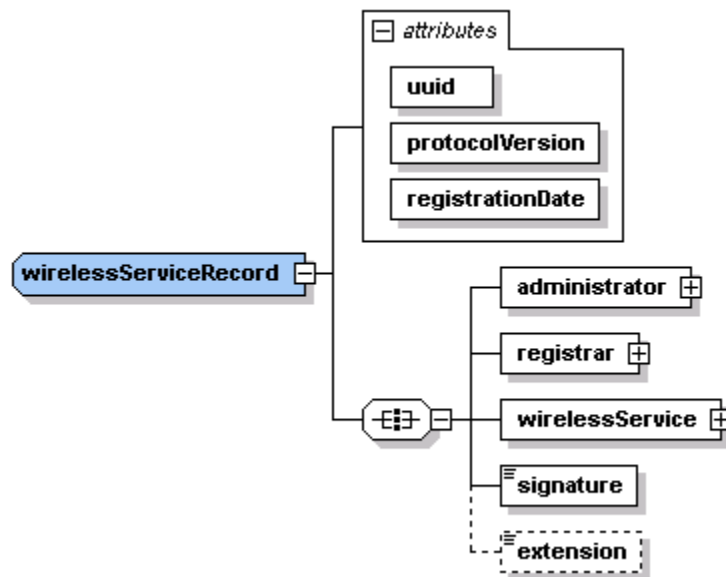
7.1.4 Validity

An administrator must identify at minimum one (1) contact. If only one contact is identified that contact must be the official designated Administrator point of contact. Other contacts may be identified and communicated at Administrator's discretion.

Administrators are designated by the Federal Communications Commission (FCC)

FCC is the registrar of all licensed wireless services derived from its databases except low power auxiliary services (such as wireless microphones) which may originate through an Administrator. Any administrator may act as a registrar of valid wireless services.

7.2 wirelessServiceRecord



The WDEF *wirelessServiceRecord* is a standardized message container that supports robust XML element encryption and may be used to encapsulate and securely exchange a WSIF *wirelessService* element.⁶

7.2.1 Definition

```

<xs:complexType name="wirelessServiceRecord">
  <xs:all>
    <xs:element name="administrator" type="administrator"/>
    <xs:element name="registrar" type="administrator"/>
    <xs:element name="wirelessService" type="wirelessService"/>
    <xs:element name="signature" type="ds:SignatureType"/>
    <xs:element name="extension" type="xs:string" minOccurs="0"/>
  </xs:all>
  <xs:attribute name="uuid" type="xs:string" use="required"/>
  <xs:attribute name="protocolVersion" type="xs:float" use="required"/>
  <xs:attribute name="registrationDate" type="xs:dateTime" use="required"/>
</xs:complexType>
  
```

⁶ See Key Bridge Global LLC, *Radio Service Information Format (RSIF)*

7.2.2 Elements

Element	Type	Documentation
administrator	administrator	<p>The party sending and signing this radio service record.</p> <p><i>Key Bridge implementation</i></p> <p>Where the <i>administrator</i> is also the <i>registrar</i> this object's <i>registrar</i> element may be partially populated and refer to this object's <i>administrator</i> element via an XPATH location. In this case, the <i>administrator</i> element shall be authoritative.</p>
registrar	administrator	<p>The originating party that created and is responsible for the content of this radio service record.</p>
wirelessService	wirelessService	<p>A WSIF <i>wirelessService</i> object.</p> <p>The wireless service information to be communicated</p>
signature	ds:SignatureType	<p>An XML Signature used to encrypt and decrypt the WSIF <i>wirelessService</i> element of this WDEF <i>wirelessServiceRecord</i> object.</p> <p><i>Key Bridge implementation</i></p> <p>This XML signature (synonymously XML-DSig) is defined in the W3C recommendation <i>XML Signature Syntax and Processing</i>.⁷</p>
extension	xs:string	<p>A URL-ENCODED string containing key/value pairs that may provide supplementary information or otherwise extend this object.</p>

7.2.3 Attributes

Attribute	Type	Documentation
uuid	xs:string	<p>A universally unique identifier assigned to this record by the sending party.</p>
protocolVersion	xs:float	<p>The message protocol version.</p>
registrationDate	xs:dateTime	<p>The date and time this wireless service record was created by an registrar.</p>

⁷ See W3C Recommendation: *XML Signature Syntax and Processing (Second Edition)* online at <http://www.w3.org/TR/xmldsig-core/>

7.2.4 Validity

Key Bridge implementation

To accommodate information forwarding, relaying and distribution by proxy a wireless service record accommodates two administrator objects labeled *administrator* and *registrar*.

A *registrar* is the authorized entity that originated (i.e. created) the *wirelessService* element of this object and is the party responsible for the *wirelessService* element's content.

If a *wirelessService* information is re-distributed for forwarded by an administrator that is not the registrar the forwarding administrator must add its own identifying information in the *administrator* element of this object.

The forwarding administrator shall update the *signature* element of this object with its own security parameters (possibly replacing the originating registrar's signature information), and the forwarding administrator's signature information shall be used to sign (and optionally encrypt) the *wirelessService* element of this object.

8 Appendix: Enumerated Codes

Key Bridge implementation

The following Name and Proper names have been assigned for system initialization plus development and testing. It is expected that prior to offering commercial service each party will create and publish their preferred UUID, designated name and proper name.

8.1 Regulators

UUID	Name	Proper Name
	FCC	Federal Communications Commission

8.2 Designated Administrators

UUID	Name	Proper Name
	AIRITY	Airity Inc.
	COMSEARCH	Comsearch
	GOOGLE	Google Inc.
	KEYBRIDGE	Key Bridge Global LLC
	LSTELCOM	LS Telcom AG
	MICROSOFT	Microsoft
	RADIOSOFT	Radiosoft
	NEUSTAR	Neustar Inc.
	SPECTRUMBRIDGE	Spectrum Bridge, Inc.
	TELCORDIA	Telcordia Technologies

8.3 Test and Development Accounts

Any number of administrator test accounts may be created by pre-pending the string “TEST_” to the administrator’s name. The following test accounts are created by default.

UUID	Name	Proper Name
	TEST_FCC	TEST FCC
	TEST_AIRITY	TEST Airity Inc.
	TEST_COMSEARCH	TEST Comsearch
	TEST_GOOGLE	TEST Google Inc.
	TEST_KEYBRIDGE	TEST Key Bridge Global LLC
	TEST_LSTELCOM	TEST LS Telcom AG
	TEST_MICROSOFT	TEST Microsoft
	TEST_RADIOSOFT	TEST Radiosoft
	TEST_NEUSTAR	TEST Neustar Inc.
	TEST_SPECTRUMBRIDGE	TEST Spectrum Bridge, Inc.
	TEST_TELCORDIA	TEST Telcordia Technologies

8.4 Administrator Contact Types

Enumerated Code Name	Description
us.ws.contactType.EXEC	A person with executive (contract signing) authority
us.ws.contactType.ADMIN	A person with decision making authority as concerns administrative issues (i.e. settlements, contract terms, policy, etc.)
us.ws.contactType.TECH	A person with authority to act as the implementation and primary operational liaison with other administrators

9 Appendix: WDEF XML Schema

The WDEF is an XML-based information encoding and formatting scheme that builds and relies upon several other standard XML schema specifications. The following specifications are included by reference:

Schema	XSD Prefix	XSD Namespace URN
XSD	xs	http://www.w3.org/2001/XMLSchema
XMLDSIG	ds	http://www.w3.org/2000/09/xmlsig

9.1 Key Bridge XML Repository

The structure of WDEF elements and documents is defined using XML Schemas language. The Schema and this document are published on the Key Bridge web site at <https://keybridgeglobal/2011/xml/>. The main file is **wdef.xsd**.

XML schema available online at http://keybridgeglobal/2011/xml/wdef.xsd
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9.2 WSIF Schema Snapshot

The following schema is provided for reference only.
THE ONLINE SCHEMA IS AUTHORITATIVE.

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" version="1.0">
  <xs:complexType name="administrator">
    <xs:sequence>
      <xs:element name="contactList" type="contact" maxOccurs="unbounded"/>
      <xs:element name="securityParameter" type="securityParameter"/>
    </xs:sequence>
    <xs:attribute name="uuid" type="xs:string" use="required"/>
    <xs:attribute name="name" type="xs:string" use="required"/>
    <xs:attribute name="properName" type="xs:string"/>
  </xs:complexType>
  <xs:complexType name="wirelessServiceRecord">
    <xs:all>
      <xs:element name="administrator" type="administrator"/>
      <xs:element name="registrar" type="administrator"/>
      <xs:element name="wirelessService" type="wirelessService"/>
      <xs:element name="signature"/>
      <xs:element name="extension" type="xs:string" minOccurs="0"/>
    </xs:all>
    <xs:attribute name="uuid" type="xs:string" use="required"/>
    <xs:attribute name="protocolVersion" type="xs:float" use="required"/>
    <xs:attribute name="registrationDate" type="xs:dateTime" use="required"/>
  </xs:complexType>
</xs:schema>
```

END